

CLAIMS

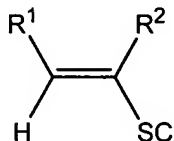
WE CLAIM:

1. A water-insoluble, crosslinked hydrophilic adhesive polymer prepared by polymerization of a composition consisting essentially of a hydrophilic monomer and a dual-function monomer that both (a) undergoes polymerization with the hydrophilic monomer and (b) provides covalent crosslinks in the polymer.

2. The polymer of claim 1, wherein the hydrophilic monomer is selected from N-vinyl amides, N-vinyl lactams, vinyl alcohols, vinyl amines, acrylic acids, methacrylic acids, hydroxyalkyl acrylates, hydroxyalkyl methacrylate, vinyl ethers, alkyl acrylates, alkyl methacrylates, acrylamides, N-alkylacrylamides, N,N-dialkylacrylamides, N-hydroxyalkylacrylamides, maleic acids, esters of maleic acids, maleic acid-co-methylvinyl ethers, esters of maleic acid-co-methylvinyl ethers, sulfoalkylacrylates, sulfoalkylmethacrylates, hydroxystyrene, allyl alcohols, crotonic acid, and itaconic acid.

3. The polymer of claim 2, wherein the hydrophilic monomer is an N-vinyl lactam.

4. The polymer of claim 1, wherein the hydrophilic monomer has the formula:



where: R¹ and R² are independently selected from hydrogen, lower alkyl, and lower hydroxyalkyl; and SC is a hydrophilic sidechain.

5. The polymer of claim 1, wherein the dual-function monomer is a poly(alkylene oxide) molecule containing about 4-40 alkylene oxide units and substituted at each terminus with a reactive group capable of undergoing vinyl polymerization.

6. The polymer of claim 5, wherein the alkylene oxide units are selected from ethylene oxide, propylene oxide, and combinations thereof.

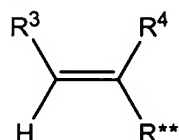
7. The polymer of claim 6 wherein the dual-function monomer is polyethylene glycol

diacrylate.

8. The polymer of claim 1, wherein the dual-function monomer is prepared by reacting a hydrophilic crosslinking agent having the formula:

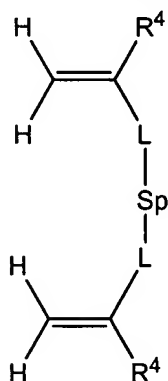


with an olefinic compound having the formula:



where: R^3 and R^4 are independently selected from hydrogen, lower alkyl, and lower hydroxyalkyl; R^* and R^{**} are reactive moieties capable of undergoing a nucleophilic addition reaction to form a covalent bond; and Sp is a hydrophilic spacer moiety.

9. The polymer of claim 8, wherein the dual-function monomer has the formula:



where L is a linkage formed by the reaction of R^* and R^{**} .

10. The polymer of claim 9, wherein R^* is a nucleophilic group and R^{**} is an electrophilic group.

11. The polymer of claim 10, wherein R^* is selected from $-NH_2$, $-NHR^5$, $-N(R^6)_2$, $-SH$, $-OH$, $-COOH$, $-PH_2$, $-PHR^7$, $-P(R^8)_2$, $-(L^3)_p MgHal$, and $-L^4Li$, where R^5 , R^6 , R^7 , and R^8 are C_1-C_6 hydrocarbyl, L^3 and L^4 are C_1-C_6 hydrocarbylene, p is zero or 1, and Hal is halo.

12. A liquid film-forming composition consisting essentially of a water-insoluble film-

forming polymer and the polymer of claim 1.

13. The composition of claim 12, wherein the water-insoluble film-forming polymer is selected from acrylate-based polymers and copolymers, polyvinylacetate, ethylene-vinylacetate copolymers, alkyl cellulose, nitrocellulose, and polysilicones.

14. A water-insoluble hydrogel composition for topical or intraoral application consisting essentially of the polymer of claim 1.

15. The composition of claim 14, further comprising a hydrophobic polymer.

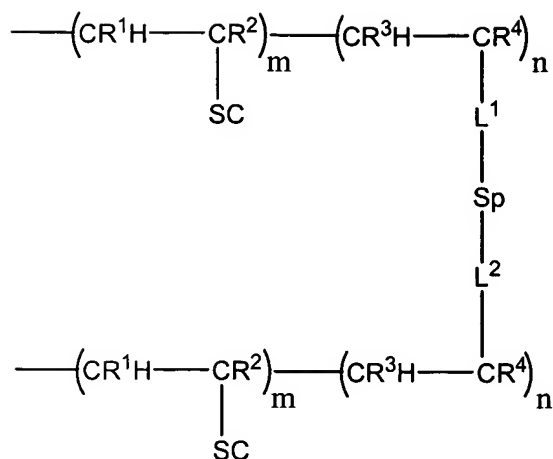
16. The composition of claim 14, further comprising an active agent.

17. The composition of claim 16, wherein the active agent is selected from bacteriostatic and bactericidal agents, antibiotic agents, pain-relieving agents, cytokines, topical vasodilators, proteolytic enzymes, and tissue-healing enhancing agents; and wherein the hydrogel is suitable for use as a wound dressing.

18. The composition of claim 14, which forms at least a portion of the body-contacting surface of a wound dressing, wherein the wound dressing comprises a laminated composite of a body facing layer having a body-contacting surface, and an outwardly facing backing layer.

19. The composition of claim 14, which forms at least one of the reservoir or the affixing means of a transdermal drug delivery device, wherein the transdermal drug delivery device comprises a drug reservoir, an outwardly facing backing layer, and a means for affixing the device to a body surface.

20. A water-insoluble, hydrophilic adhesive polymer having the formula:



where:

m is an integer in the range of 0 to 100,000;

n is an integer in the range of 1 to 100,000;

R¹, R², R³, and R⁴ are independently selected from hydrogen, lower alkyl, and lower hydroxyalkyl;

SC is a hydrophilic side chain;

L¹ and L² are linkages that are independently selected from -(CO)-O-, -O-(CO)-, -O-(CO)-O-, -(CO)-NH-, -NH-(CO)-, -O-(CO)-NH-, -NH-(CO)-O-, -S-S-, -S-(CO)-, and -(CO)-S-; and

Sp is a poly(alkylene oxide) linker containing about 4-40 alkylene oxide units.

21. The polymer of claim 20, where:

R¹, R², and R³ are hydrogen;

R⁴ is selected from hydrogen, methyl, and hydroxymethyl;

SC is a poly(alkylene oxide) side chain containing about 4-20 alkylene oxide units; and

L¹ and L² are -(CO)-O-.

22. The polymer of claim 20, where m is an integer in the range of 1 to 100,000, and the polymer is prepared by polymerization of a composition consisting essentially of a hydrophilic monomer and a dual-function monomer that both (a) undergoes polymerization with the hydrophilic monomer and (b) provides covalent crosslinks in the polymer.

23. The polymer of claim 20, where m is 0 and the polymer is prepared by

homopolymerization of a composition consisting essentially of dual-function monomers selected from poly(ethylene glycol diacrylate) and poly(ethylene glycol) dimethacrylate, in the absence of any hydrophilic monomers.

24. A water-soluble, hydrophilic adhesive polymer that is free of covalent crosslinks, wherein the polymer is prepared by polymerization of a composition consisting essentially of a hydrophilic monomer and an acrylic acid monomer esterified with a hydrophilic side chain.

25. The polymer of claim 24, wherein the hydrophilic monomer is selected from N-vinyl amides, N-vinyl lactams, vinyl alcohols, vinyl amines, acrylic acids, methacrylic acids, hydroxyalkyl acrylates, hydroxyalkyl methacrylate, vinyl ethers, alkyl acrylates, alkyl methacrylates, acrylamides, N-alkylacrylamides, N,N-dialkylacrylamides, N-hydroxyalkylacrylamides, maleic acids, esters of maleic acids, maleic acid-co-methylvinyl ethers, esters of maleic acid-co-methylvinyl ethers, sulfoalkylacrylates, sulfoalkylmethacrylates, hydroxystyrene, allyl alcohols, crotonic acid, and itaconic acid.

26. The polymer of claim 25, wherein the hydrophilic monomer is an N-vinyl lactam.

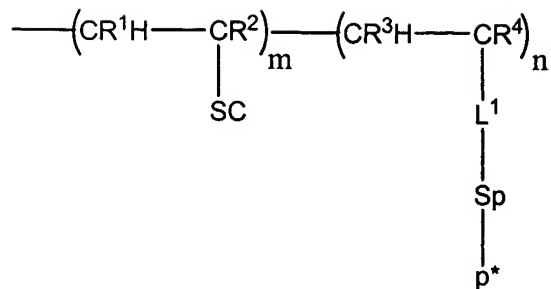
27. The polymer of claim 24, wherein the acrylic acid monomer is esterified with a poly(alkylene oxide) chain containing about 4-40 alkylene oxide units.

28. The polymer of claim 27, wherein the acrylic acid monomer is selected from polyethylene glycol monoacrylate and polyethylene glycol monomethacrylate.

29. A liquid film-forming composition consisting essentially of a water-insoluble film-forming polymer and the polymer of claim 24.

30. The composition of claim 29, wherein the water-insoluble film-forming polymer is selected from acrylate-based polymers and copolymers, polyvinylacetate, ethylene-vinylacetate copolymers, alkyl cellulose, nitrocellulose, and polysilicones.

31. A water-insoluble hydrogel composition for topical or intraoral application consisting essentially of a water-insoluble film-forming polymer and the polymer of claim 24.
32. The composition of claim 31, wherein the water-insoluble film-forming polymer is selected from acrylate-based polymers and copolymers, polyvinylacetate, ethylene-vinylacetate copolymers, alkyl cellulose, nitrocellulose, and polysilicones.
33. The composition of claim 31, further comprising a hydrophobic polymer.
34. The composition of claim 31, further comprising an active agent.
35. The composition of claim 34, wherein the active agent is selected from bacteriostatic and bactericidal agents, antibiotic agents, pain-relieving agents, cytokines, topical vasodilators, proteolytic enzymes, and tissue-healing enhancing agents; and wherein the hydrogel is suitable for use as a wound dressing.
36. The composition of claim 31, which forms at least a portion of the body-contacting surface of a wound dressing, wherein the wound dressing comprises a laminated composite of a body facing layer having a body-contacting surface, and an outwardly facing backing layer.
37. The composition of claim 31, which forms at least one of the reservoir or the affixing means of a transdermal drug delivery device, wherein the transdermal drug delivery device comprises a drug reservoir, an outwardly facing backing layer, and a means for affixing the device to a body surface.
38. A water-soluble, hydrophilic adhesive polymer that is free of covalent crosslinks, having the formula:



where:

m is an integer in the range of 0 to 100,000;

n is an integer in the range of 1 to 100,000;

R¹, R², R³, and R⁴ are independently selected from hydrogen, lower alkyl, and lower hydroxyalkyl;

SC is a hydrophilic side chain;

L¹ is selected from -(CO)-O-, -O-(CO)-, -O-(CO)-O-, -(CO)-NH-, -NH-(CO)-, -O-(CO)-NH-, -NH-(CO)-O-, -S-S-, -S-(CO)-, and -(CO)-S-;

Sp is a poly(alkylene oxide) linker containing about 4-40 alkylene oxide units; and

P* is a polar moiety.

39. The polymer of claim 38, where:

R¹, R², and R³ are hydrogen;

R⁴ is selected from hydrogen, methyl, and hydroxymethyl;

SC is a poly(alkylene oxide) side chain containing about 4-20 alkylene oxide units;

L¹ is -(CO)-O-; and

P* is a hydroxyl group.

40. The polymer of claim 38, where m is an integer in the range of 1 to 100,000, and the polymer is prepared by polymerization of a composition consisting essentially of a hydrophilic monomer and an acrylic acid monomer esterified with a hydrophilic side chain.

41. The polymer of claim 38, where m is 0 and the polymer is prepared by homopolymerization of a composition consisting essentially of dual-function monomers selected from poly(ethylene glycol monoacrylate) and poly(ethylene glycol) monomethacrylates, in the absence of any hydrophilic monomers.

42. A water-insoluble adhesive polymer, wherein the polymer is prepared by polymerization of a composition consisting essentially of: (a) a hydrophilic monomer, an acrylic acid monomer esterified with a hydrophilic side chain, and an acrylate monomer; (b) a hydrophilic monomer, an acrylic acid monomer esterified with a hydrophilic side chain, and a dual-function monomer; or (c) an acrylate monomer, an acrylic acid monomer esterified with a hydrophilic side chain, and a dual-function monomer.

43. The polymer of claim 42, wherein the hydrophilic monomer is selected from N-vinyl amides, N-vinyl lactams, vinyl alcohols, vinyl amines, acrylic acids, methacrylic acids, hydroxyalkyl acrylates, hydroxyalkyl methacrylate, vinyl ethers, alkyl acrylates, alkyl methacrylates, acrylamides, N-alkylacrylamides, N,N-dialkylacrylamides, N-hydroxyalkylacrylamides, maleic acids, esters of maleic acids, maleic acid-co-methylvinyl ethers, esters of maleic acid-co-methylvinyl ethers, sulfoalkylacrylates, sulfoalkylmethacrylates, hydroxystyrene, allyl alcohols, crotonic acid, and itaconic acid.

44. The polymer of claim 43, wherein the hydrophilic monomer is an N-vinyl lactam.

45. The polymer of claim 42, wherein the acrylate monomer is selected from acrylates, methacrylates, lower alkyl acrylates, 2-substituted lower alkyl acrylates, lower alkyl methacrylates, hydroxyalkyl acrylates, and hydroxyalkyl methacrylates.

46. The polymer of claim 42, wherein the acrylic acid monomer is esterified with a poly(alkylene oxide) chain containing about 4-40 alkylene oxide units.

47. The polymer of claim 46, wherein the acrylic acid monomer is selected from polyethylene glycol monoacrylate and polyethylene glycol monomethacrylate.

48. The polymer of claim 42, wherein the dual-function monomer is polyethylene glycol diacrylate.

49. A water-insoluble hydrogel composition for topical or intraoral application consisting essentially of the polymer of claim 42.
50. The composition of claim 49, further comprising a hydrophobic polymer.
51. The composition of claim 49, further comprising an active agent.
52. The composition of claim 51, wherein the active agent is selected from bacteriostatic and bactericidal agents, antibiotic agents, pain-relieving agents, cytokines, topical vasodilators, proteolytic enzymes, and tissue-healing enhancing agents; and wherein the hydrogel is suitable for use as a wound dressing.
53. The composition of claim 49, which forms at least a portion of the body-contacting surface of a wound dressing, wherein the wound dressing comprises a laminated composite of a body facing layer having a body-contacting surface, and an outwardly facing backing layer.
54. The composition of claim 49, which forms at least one of the reservoir or the affixing means of a transdermal drug delivery device, wherein the transdermal drug delivery device comprises a drug reservoir, an outwardly facing backing layer, and a means for affixing the device to a body surface.
55. A water-insoluble, hydrophilic adhesive polymer blend that is free of covalent crosslinks, consisting essentially of at least one hydrophilic long-chain polymer and at least one amphiphilic crosslinker.
56. The polymer blend of claim 55, wherein the hydrophilic long-chain polymer is selected from poly(N-vinyl amides), polyethylene oxide-co-vinyl alcohols, poly(acrylamides), poly (N-alkylacrylamides), poly(N,N-dialkylacrylamides), poly(N-hydroxyalkylacrylamides), poly(maleic acids), poly maleic acid-co-methylvinyl ethers, poly(sulfoalkylacrylates), poly(sulfoalkylmethacrylates), polyacrylic acids, polymethacrylic acids, poly(N-vinyl lactams), polyvinyl alcohols, poly(hydroxyalkyl acrylates), poly(hydroxyalkyl methacrylates), and salts and

copolymers thereof; alginic acid, chitosan, hydroxypropylcellulose, hydroxyethyl cellulose, methylcellulose, hydroxypropyl methylcellulose, and carboxymethylcellulose, and salts thereof.

57. The polymer blend of claim 56, wherein the hydrophilic long-chain polymer is a poly(N-vinyl lactam).

58. The polymer blend of claim 55, wherein the amphiphilic crosslinker is selected from fatty acids, ionic and nonionic surfactants, and non-steroidal anti-inflammatory drugs.

59. The polymer blend of claim 55, which is in the form of an elastic adhesive film.

60. A liquid film-forming composition consisting essentially of a water-insoluble film-forming polymer and the polymer blend of claim 55.

61. The composition of claim 60, wherein the water-insoluble film-forming polymer is selected from acrylate-based polymers and copolymers, polyvinylacetate, ethylene-vinylacetate copolymers, alkyl cellulose, nitrocellulose, and polysilicones.

62. A water-insoluble hydrogel composition for topical or intraoral application consisting essentially of the polymer blend of claim 55.

63. The composition of claim 62, further comprising a hydrophobic polymer.

64. The composition of claim 62, further comprising an active agent.

65. The composition of claim 64, wherein the active agent is selected from bacteriostatic and bactericidal agents, antibiotic agents, pain-relieving agents, cytokines, topical vasodilators, proteolytic enzymes, and tissue-healing enhancing agents; and wherein the hydrogel is suitable for use as a wound dressing.

66. The composition of claim 62, which forms at least a portion of the body-contacting

surface of a wound dressing, wherein the wound dressing comprises a laminated composite of a body facing layer having a body-contacting surface, and an outwardly facing backing layer.

67. The composition of claim 62, which forms at least one of the reservoir or the affixing means of a transdermal drug delivery device, wherein the transdermal drug delivery device comprises a drug reservoir, an outwardly facing backing layer, and a means for affixing the device to a body surface.

68. A water-insoluble, hydrophilic covalently crosslinked adhesive polymer blend prepared by polymerization of a hydrophilic acrylic monomer in the presence of a hydrophilic water-soluble high molecular weight polymer or copolymer, a dual function crosslinker or multi-function crosslinker, and an optional plasticizer.

69. The polymer blend of claim 68, wherein the hydrophilic acrylic monomer is selected from vinyl amines, acrylic acids, methacrylic acids, hydroxyalkyl acrylates, hydroxyalkyl methacrylate, vinyl ethers, alkyl acrylates, alkyl methacrylates, acrylamides, N-alkylacrylamides, N,N-dialkylacrylamides, N-hydroxyalkylacrylamides, maleic acids, esters of maleic acids, maleic acid-co-methylvinyl ethers, esters of maleic acid-co-methylvinyl ethers, sulfoalkylacrylates, sulfoalkylmethacrylates, hydroxystyrene, allyl alcohols, crotonic acid, and itaconic acid.

70. The polymer blend of claim 68, wherein the hydrophilic water-soluble high molecular weight polymer or copolymer is selected from poly(N-vinyl amides), poly(N-vinyl lactams), polyvinyl alcohols, poly vinyl amines, polyacrylic acids, polymethacrylic acids, polyhydroxyalkyl acrylates, polyhydroxyalkyl methacrylates, polyacrylamides, poly(N-alkylacrylamides), poly(N,N-dialkylacrylamides), poly(N-hydroxyalkylacrylamides), polymaleic acids, esters of polymaleic acids, polymaleic acid-co-methylvinyl ethers, esters of polymaleic acid-co-methylvinyl ethers, polysulfoalkylacrylates, polysulfoalkylmethacrylates, and combinations thereof.

71. The polymer blend of claim 70, wherein the hydrophilic water-soluble high molecular weight polymer or copolymer is a poly(N-vinyl lactam).

72. The polymer blend of claim 68, wherein the dual function crosslinker or multi-function crosslinker is selected from polyethyleneglycol diacrylate, dipentaerythritol pentaacrylate, trimethylolpropane triacrylate, and ethoxylated trimethylolpropane triacrylate.
73. The polymer blend of claim 68, wherein the plasticizer is included, and is selected from polyethyleneglycol, glycerol, 1,2-propylenglycol, 2-methyl-1,3-propanediol, and water.
74. A water-insoluble hydrogel composition for topical or intraoral application consisting essentially of the polymer blend of claim 68.
75. The composition of claim 74, further comprising a hydrophobic polymer.
76. The composition of claim 74, further comprising an active agent.
77. The composition of claim 76, wherein the active agent is selected from bacteriostatic and bactericidal agents, antibiotic agents, pain-relieving agents, cytokines, topical vasodilators, proteolytic enzymes, and tissue-healing enhancing agents; and wherein the hydrogel is suitable for use as a wound dressing.
78. The composition of claim 74, which forms at least a portion of the body-contacting surface of a wound dressing, wherein the wound dressing comprises a laminated composite of a body facing layer having a body-contacting surface, and an outwardly facing backing layer.
79. The composition of claim 74, which forms at least one of the reservoir or the affixing means of a transdermal drug delivery device, wherein the transdermal drug delivery device comprises a drug reservoir, an outwardly facing backing layer, and a means for affixing the device to a body surface.
80. A water-insoluble, hydrophilic covalently crosslinked adhesive polymer blend prepared by polymerization of a hydrophilic water-soluble high molecular weight polymer or copolymer, a

dual function crosslinker or multi-function crosslinker, and an optional plasticizer.

81. The polymer blend of claim 80, wherein the hydrophilic water-soluble high molecular weight polymer or copolymer is selected from poly(N-vinyl amides), poly(N-vinyl lactams), polyvinyl alcohols, poly vinyl amines, polyacrylic acids, polymethacrylic acids, polyhydroxyalkyl acrylates, polyhydroxyalkyl methacrylates, polyacrylamides, poly(N-alkylacrylamides), poly(N,N-dialkylacrylamides), poly(N-hydroxyalkylacrylamides), polymaleic acids, esters of polymaleic acids, polymaleic acid-co-methylvinyl ethers, esters of polymaleic acid-co-methylvinyl ethers, polysulfoalkylacrylates, polysulfoalkylmethacrylates, and combinations thereof.

82. The polymer blend of claim 81, wherein the hydrophilic water-soluble high molecular weight polymer or copolymer is a poly(N-vinyl lactam).

83. The polymer blend of claim 80, wherein the dual function crosslinker or multi-function crosslinker is selected from polyethyleneglycol diacrylate, dipentaerythritol pentaacrylate, trimethylolpropane triacrylate, and ethoxylated trimethylolpropane triacrylate.

84. The polymer blend of claim 80, wherein the plasticizer is included, and is selected from polyethyleneglycol, glycerol, 1,2-propylenglycol, 2-methyl-1,3-propanediol, and water.

85. A water-insoluble hydrogel composition for topical or intraoral application consisting essentially of the polymer blend of claim 80.

86. The composition of claim 85, further comprising a hydrophobic polymer.

87. The composition of claim 85, further comprising an active agent.

88. The composition of claim 87, wherein the active agent is selected from bacteriostatic and bactericidal agents, antibiotic agents, pain-relieving agents, cytokines, topical vasodilators, proteolytic enzymes, and tissue-healing enhancing agents; and wherein the hydrogel is suitable

for use as a wound dressing.

89. The composition of claim 85, which forms at least a portion of the body-contacting surface of a wound dressing, wherein the wound dressing comprises a laminated composite of a body facing layer having a body-contacting surface, and an outwardly facing backing layer.

90. The composition of claim 85, which forms at least one of the reservoir or the affixing means of a transdermal drug delivery device, wherein the transdermal drug delivery device comprises a drug reservoir, an outwardly facing backing layer, and a means for affixing the device to a body surface.